

ZPS and ZRS Modulating Scroll

Introduction

The two step modulated scroll is based upon the very successful ZR16K4 to ZR61K3 single capacity scroll. Typical Model Numbers are ZRS43K4-PFV (R-22) or ZPS40K4E-PFV (R-410A).

The basic scroll design has been modified with the addition of an internal unloading mechanism that opens a by-pass port in the first compression pocket, effectively reducing the displacement of the scroll. The opening and closing of the by-pass port is controlled by an internal electrically operated solenoid. **See Fig. 1.** The ZPS/ZRS modulated scroll uses a single step of unloading to go from full capacity to approximately 67% capacity. **See Fig. 2.** A single speed, high efficiency motor continues to run while the scroll modulates between the two capacity steps. More technical information is available in the "Online Product Information" section at www.emersonclimatecustomer.com.

Application Considerations

In most respects the two step modulated scroll will operate like a standard scroll in both the high and low capacity mode. The basic application guidelines in Application Bulletin 4-1331 for R-410A and 4-1312

for R-22 must be followed for this compressor, including recommendations for system testing as outlined by the "Application Diagram". The modulated scroll has standard internal protection such as an IPR valve and inherent motor protector but does not have the Thermodisc® high discharge temperature protection. These internal protection devices are described in AE Bulletin 4-1331 and 4-1312.

There are a few important differences outlined below that must be observed when designing a system with the two step scroll.

Operating Envelope

The maximum operating condensing pressure varies for the ZPS and ZRS scrolls. Please see Figure 3 and Chart 1 for condensing pressure limits. The maximum condensing limit is the point where the compressor can still run with a low supply voltage of 197 for the -PFV (208-230 volt) and -10% for all other motors. The ZPS and ZRS scrolls can operate at both full- and part-load capacity throughout the entire operating envelope shown in **Figure 3.**

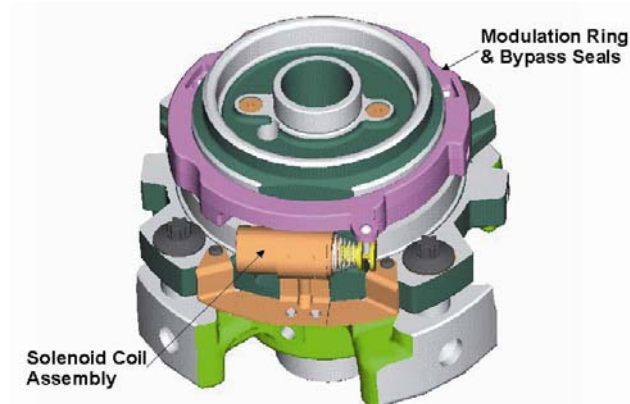


Figure 1

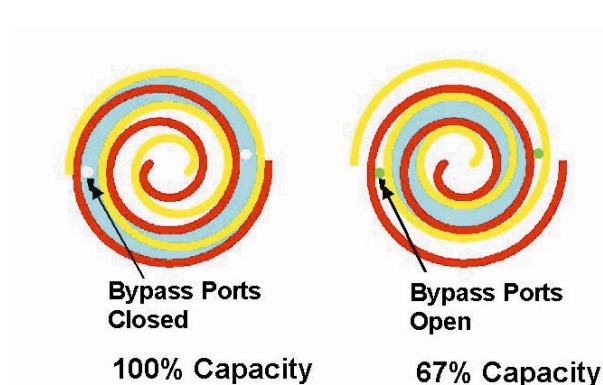


Figure 2

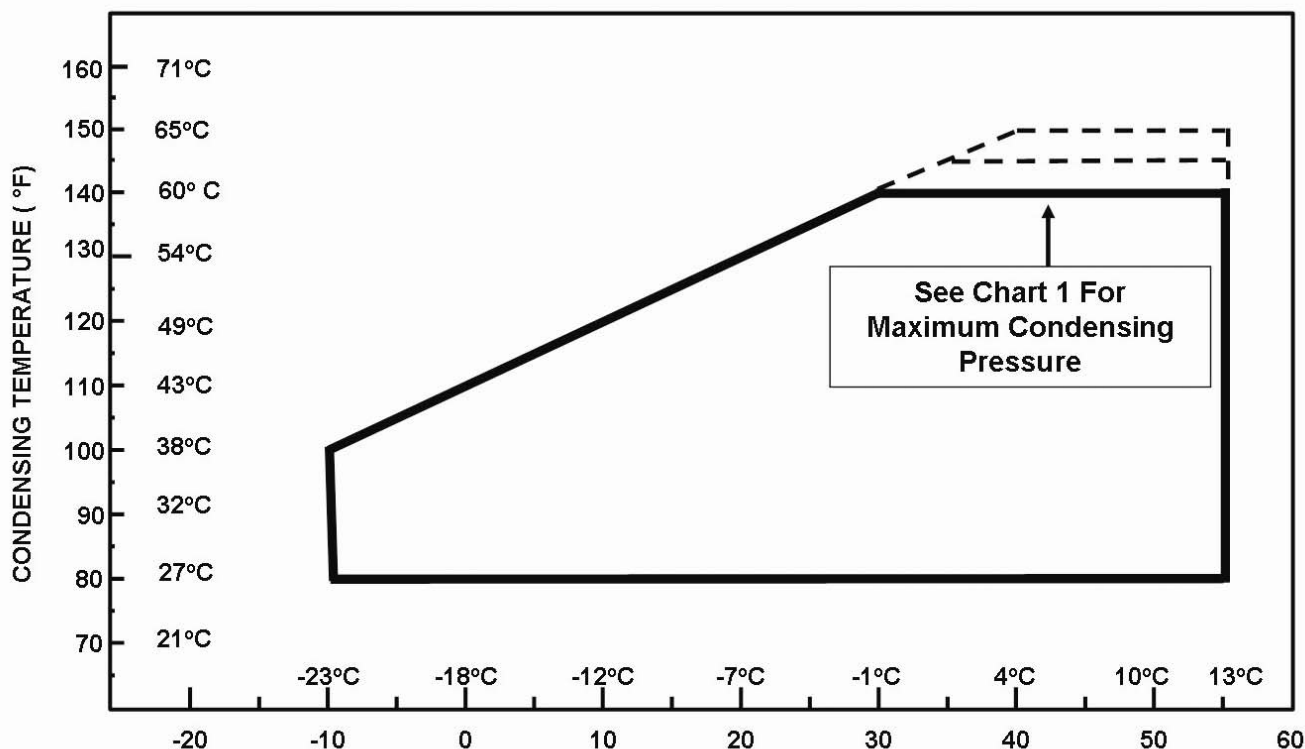


Figure 3

CHART 1

Model	Max CT	Charge Limit * Lbs/kg	Frame Size*
ZPS20K4E	140°F/60°C	9.6/3.6	63
ZPS26K4E	145°F/63°C	9.6/3.6	63
ZPS30K4E	140°F/60°C	9.6/3.6	63
ZPS35K4E	145°F/63°C	9.6/3.6	63
ZPS40K4E	140°F/60°C	9.6/3.6	63
ZPS51K4E	140°F/60°C	12.0/4.5	70
ZPS60K4E	145°F/63°C	12.0/4.5	70
ZRS43K4	150°F/65°C	9.6/3.6	63
ZRS52K4	140°F/60°C	12.0/4.5	70

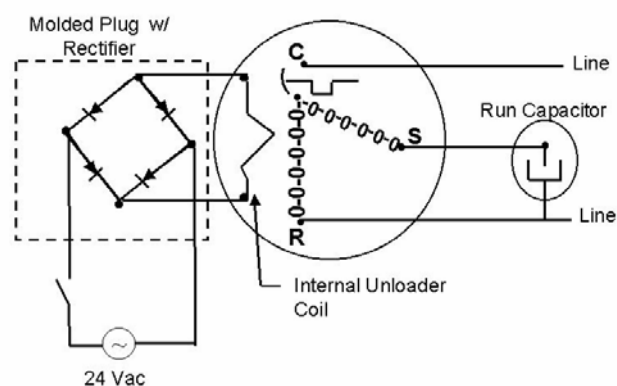


Figure 4

* See AE bulletins 4-1312 & 4-1331, Table 5, for explanation.

Capacity Control

The compression process of a scroll is described in **AE Bulletin 4-1312, Figure 7**. At any point in the compression process, there are several pockets within the scroll that are compressing gas. Modulation is achieved by venting a portion of the gas in the first suction pocket back to the low side of the compressor thereby reducing the effective displacement of the compressor. See **Figure 2**. Full capacity is achieved by blocking these vents, thus increasing the displacement to 100%. A dc solenoid in the compressor, controlled by a rectified external 24 volt ac signal, moves the slider ring that covers and uncovers these vents. The vent covers are arranged in such a manner that the compressor operates somewhere around 67% capacity when the solenoid is not energized and 100% capacity when the solenoid is energized. The loading and unloading of the two step scroll is done "on the fly" without shutting off the motor between steps. See wiring diagram **Fig. 4**. The unloaded mode default was chosen for two reasons:

1. It is expected that the majority of run hours will be in the low capacity, unloaded mode.
2. It allows a simple two-stage thermostat to control capacity through the second stage in both cooling and possibly heating if desired.

Unloader solenoid

Standard wiring without Comfort Alert Module

A nominal 24-volt direct current coil activates the internal unloader solenoid. The input control circuit voltage must be 18 to 28 volt AC. The coil power requirement is 20 VA. The external electrical connection is made with a molded plug assembly 529-0061-00. This plug contains a full wave rectifier to supply direct current to the unloader coil.

Unloader Test Procedure

If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor amperage. Cycle the unloader on and off at ten second intervals. The compressor amperage should go up or down at least 25 percent (1).
2. If step one does not give the expected results shut unit off. Apply 18 to 28 volt AC to the unloader molded plug leads and listen for a click as the solenoid pulls in. Remove power and listen for another click as the unloader returns to its original position.
3. If clicks can't be heard, shut off power and remove the control circuit molded plug from the compressor and measure the unloader coil resistance. The resistance should be 32 to 60 ohms depending on compressor temperature.
4. Next check the molded plug.

Voltage check: Apply control voltage to the plug wires (18 to 28 volt ac). The measured DC voltage at the female connectors in the plug should be around 15 to 27 VDC.

Resistance check: Measure the resistance from the end of one molded plug lead to either of the two female connectors in the plug. One of the connectors should read close to zero ohms while the other should read infinity. Repeat with other wire. The same female connector as before should read zero while the other connector again reads infinity. Reverse polarity on the ohmmeter leads and repeat. The female connector that read infinity previously should now read close to zero ohms.

Replace plug if either of these test methods doesn't show the desired results.

Wired with Comfort Alert Module

Please read Form No. 2004ECT-208 to understand the functioning of this module. The Comfort Alert module, part number 543-0033-00, is a diagnostic tool that is installed separately in the electrical box of the unit. It monitors and analyzes the status of the scroll compressor and detects and communicates any system or compressor problems without using external sensors that would have to be installed into the system. Any faults are translated through a blinking LED that can guide the technician quickly and accurately to the root cause of a problem.

One of the advantages of using this module with the modulating compressor is that the rectifier, which is located in the modulating coil external power plug, is not used but is now in the module itself. This means the plug used with the module, part number 529-0369-00, is an ordinary two wire plug and therefore less expensive. This module will always start the compressor unloaded and keep it unloaded for five seconds even when the second stage of the thermostat is calling for more capacity, a definite starting advantage under low voltage conditions.

Unloader Test Procedure with 543-0033-00 Comfort Alert Module

If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor amperage. Cycle the unloader on and off at ten plus second intervals by applying and removing Y2 voltage to the module. Wait five seconds after power is applied to Y2 before taking a reading. The compressor amperage should go up or down at least 25 percent(1).
2. If step one does not give the expected results remove the solenoid plug from the compressor and with the unit running and the thermostat calling for Y2 to be energized test the voltage output at the plug with a dc voltmeter. The reading here should be 4 to 18 volts. If not, unplug the harness from the module and check voltage at the "DC Sol" pins of the module. Please refer to "Comfort Alert Ultra Tech Diagnostics" manual, Form #2004ECT-208, available on-line. The module will not power the unloader solenoid if the compressor is not running or fault code 1 or 9 is active.
3. If the correct DC voltage is at the control circuit molded plug measure the unloader coil resistance. The resistance should be 32 to 60 ohms depending on compressor temperature. If the coil resistance is infinity, much lower than 32 ohms, or is grounded the compressor must be replaced.
 - (1) A saturated condensing temperature below 80°F (27°C) may not produce as wide a change in amperage.

UNLOADER SOLENOID PLUG	
529-0061-00	WITH RECTIFIER
529-0062-00	WITHOUT RECTIFIER. USE WITH 543-0033-00 MODULE.

Safety Control Requirements

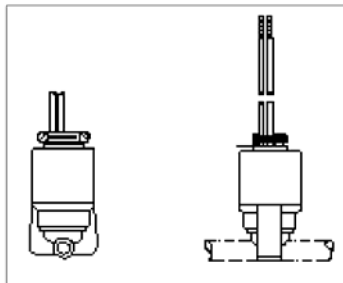
High Pressure Control: Installing a high pressure control in the system is optional with this product. If a high pressure control is used in the system it is recommended that a manual reset control be used, since it is very rare that the condition that caused the control to trip will correct itself without service intervention. The recommended cutout should be no higher than 425 psig (30 kg/cm²) for R-22 and 645 psig (45 kg/cm²) for R-410A.

Low Pressure Control: A low pressure control is **mandatory** and must be installed in the system for loss-of-charge protection on this modulating scroll. In a system that is very low on charge, the modulating solenoid will overheat and burn out if energized. The cut-out should be set no lower than 25 psig (1.75 kg/cm²) for R-22 and 50 psig (50 kg/cm²) for R410A. An energized unloader coil will not overheat should the compressor trip on its motor protector, provided there is proper refrigerant charge in the system. The low pressure control should be installed in the common line of the control circuit to shut off both the unit and the solenoid power.

Discharge Line Thermostat: Some systems, such as air-to-air heat pumps, may not work with the above low pressure control arrangement. A discharge line thermostat set to shut the compressor off before the discharge temperature exceeds 290°F (143°C) may have to be used in conjunction with a low pressure control installed in the liquid line to achieve the same protection. Mount the discharge thermostat as close as possible to the compressor discharge fitting and insulate well. See **Figure 5** for recommended Copeland part numbers.

Start Components								
	Start Capacitors			Relays				
Model	MFD	Volts	Part Number	G.E. p/n	Copeland p/n	Pick-up Volts	Drop-out Volts	Coil Voltage
ZPS20K4E-PFV	88-108	330	014-0036-03	3ARR3KC3LP	040-0140-08	140-150	40-90	332
ZPS26K4E-PFV	88-108	330	014-0036-03	3ARR3KC3P5	040-0001-79	170-180	40-90	332
ZPS30K4E-PFV	88-108	330	014-0036-03	3ARR3KC5M5	040-0001-62	150-160	35-77	253
ZPS35K4E-PFV	88-108	330	014-0036-03	3ARR3KC3P5	040-0001-79	170-180	40-90	332
ZPS40K4E-PFV	88-108	330	014-0036-03	3ARR3KC3P5	040-0001-79	170-180	40-90	332
ZPS51K4E-PFV	270-324	330	014-0006-10	3ARR3KC3L5	040-0140-08	140-150	40-90	332
ZPS60K4E-PFV	270-324	330	014-0006-10	3ARR3KC3L5	040-0140-08	140-150	40-90	332
ZRS43K4-PFV	88-108	330	014-0036-03	3ARR3KC3P5	040-0001-79	170-180	40-90	332
ZRS52K4-PFV	175-216	330	014-0006-12	3ARR3KC3L5	040-0140-08	140-150	40-90	332

Discharge Thermostat



Part Number	Kit Part No.	Max. Voltage	Max. Contact Rating
071-0540-02	998-0540-02	240	5A @ 240V
085-7022-00*	998-7022-02	240	5A @ 240V
*For conduit use.			

Figure 5